TUTORIAL 1

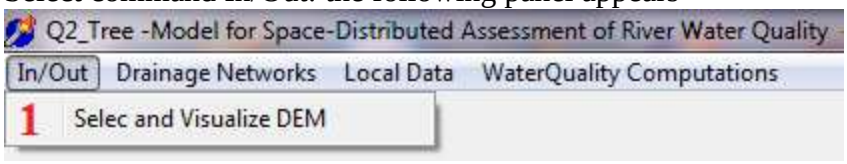
test case 1: *test1_2017.grd*

The first case described in the companion paper is a 200-km long river discretised in 100, 2-km long stretches.These geometrical features of the DEM are automatically specified in the header of the input *.grd file that is read by the program

```
ncols         1
nrows         100
xllcorner       1000000.00
yllcorner       1000000.00
cellsize      2000
NODATA_value  -9
```

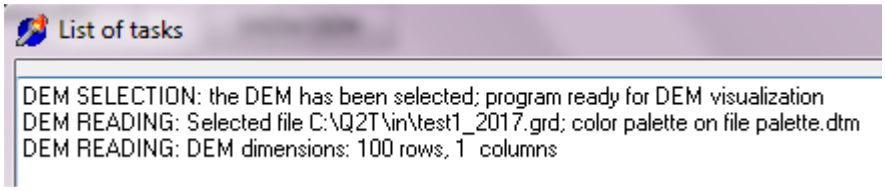
Run the Q2T program by clicking on the *Q2T.exe* icon.

Select command In/Out: the following panel appears

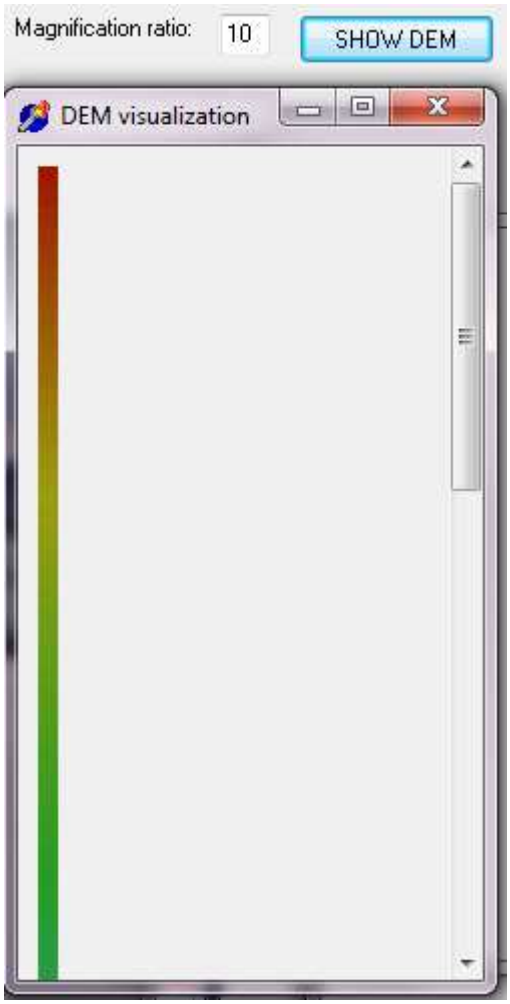


Using command 1 above, select the file *test1_2017.grd*. Upon selection, a panel shows up where the magnification ratio for the DEM visualization on the screen can be selected. The default value is 3 but this value should be better changed on the basis of the actual dimension of the DEM.

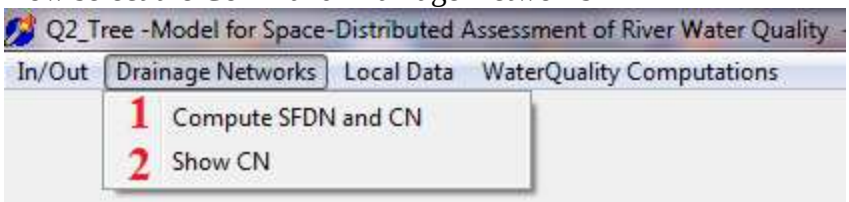
In our case the DEM is made up of 100 rows and 1 column. This dimension is also reported in the "List of Tasks" panel, where each operation done by the program is recorded



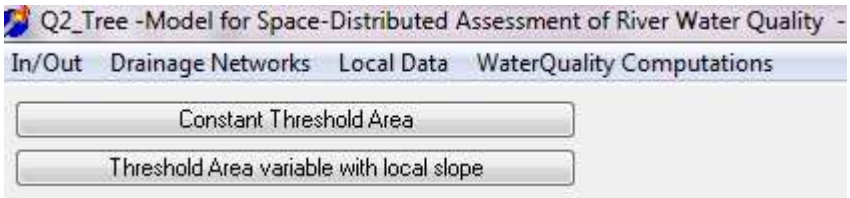
In order to choose a value, one can consider that the dimension of the window where the DEM is shown, is given by the number of rows and colums of the DEM, scaled with the magnification ratio, that is a real number > 0. For instance, a 400x400 DEM with a 0.5 magnification ratio occupies a 200x200 dots window.
Accordingly, in order to make the DEM visible on the screen, we select a magnification ratio = 10 and then we select the SHOW DEM button. The Watershed Visualizer panel below will show up on the screen, where the DEM (in this case a line of cells) is represented with color scaling from brown (highest elevation in the watershed) down to blue (lowest elevation). The actual local elevation can be known by using the Local Data , Info_xyz commands, and this option will be explored in the second Tutorial.



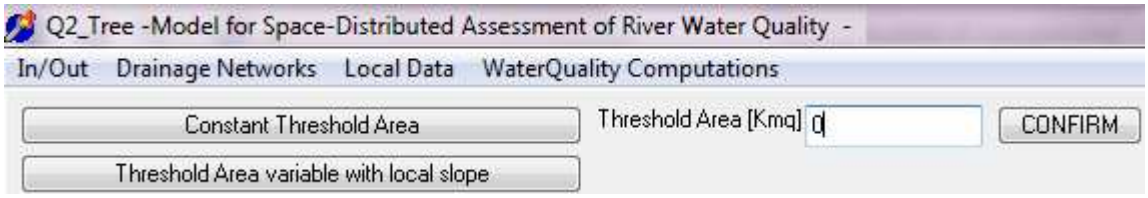
Now select the Command Drainage Networks



Here select command 1: Compute SFDN and CN.
The panel will appear

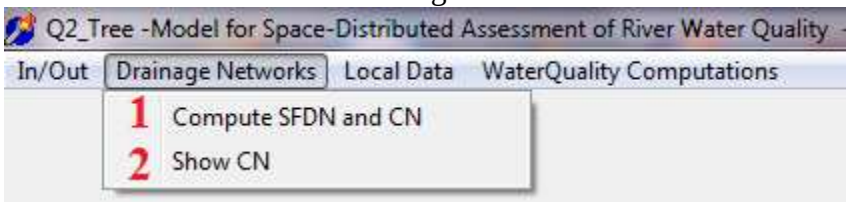


On the basis of this choice, the CN will be obtained by the automatically computed SFDN using either a constant Threshold Area or a Threshold Area that changes with the local slope. Let us select the first option, and insert 0 as threshold area



On the basis of this choice the CN will coincide with the SFDN. Press CONFIRM

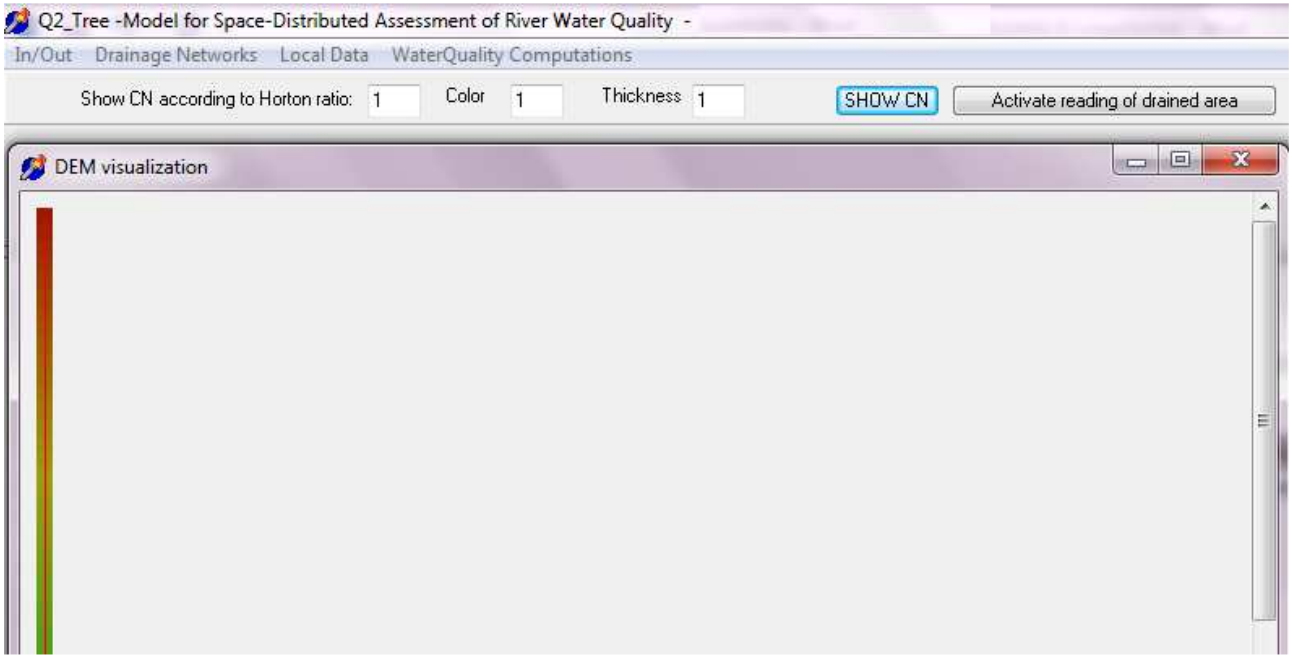
Now select the Command Drainage Networks



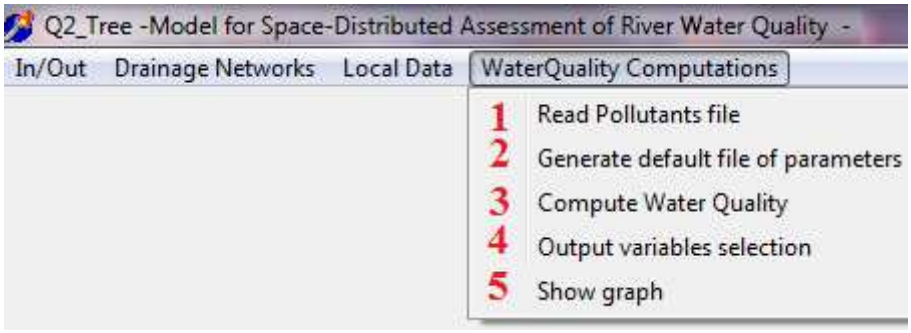
Here select command 2: Show CN.
The panel will appear

By this command the CN can be shown, filtered according to Horton's ratio. Simply press SHOW CN and the CN will appear as a red line superimposed on the DEM. Please note that if a too small value of the Magnification Ratio has been selected, the thin red line of the CN that is superimposed to the DEM can be hardly noticeable. The outlet of the watershed is always marked by a red cell.

Another Button (Activate Reading of Drained Area) will appear too but it is of little use in this test case and we'll consider it later in test case 3. At this stage both the SFDN and CN have been computed.



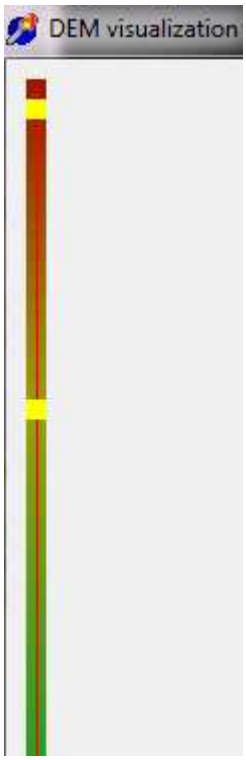
Now it is time to go to the Water quality Model. Select the Command Water Quality Computations



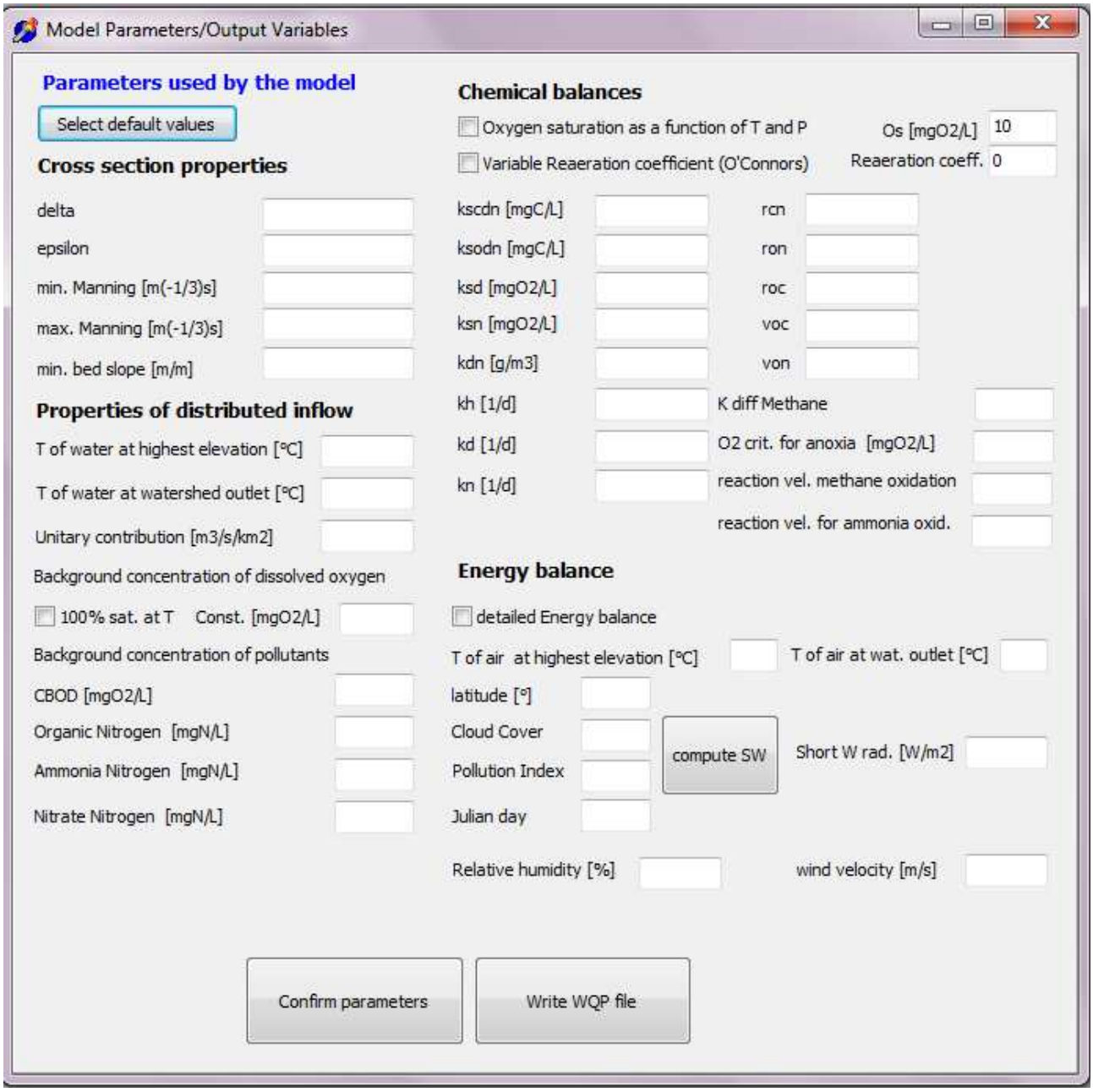
Select Command 1 to read the user-defined list of pollutant sources and water diversions. Here select the file Test1_2017.inp. This file is an unformatted ASCII file that contains the following information:

r	c	Q_immission	T	Ci_imm i=1..5					Q_diversion
2	1	6.0000	20.0	2.00	0.2	0.1	1	10.00	0
17	1	1.0000	20.0	40.00	12.00	16.0	0.0	2	0

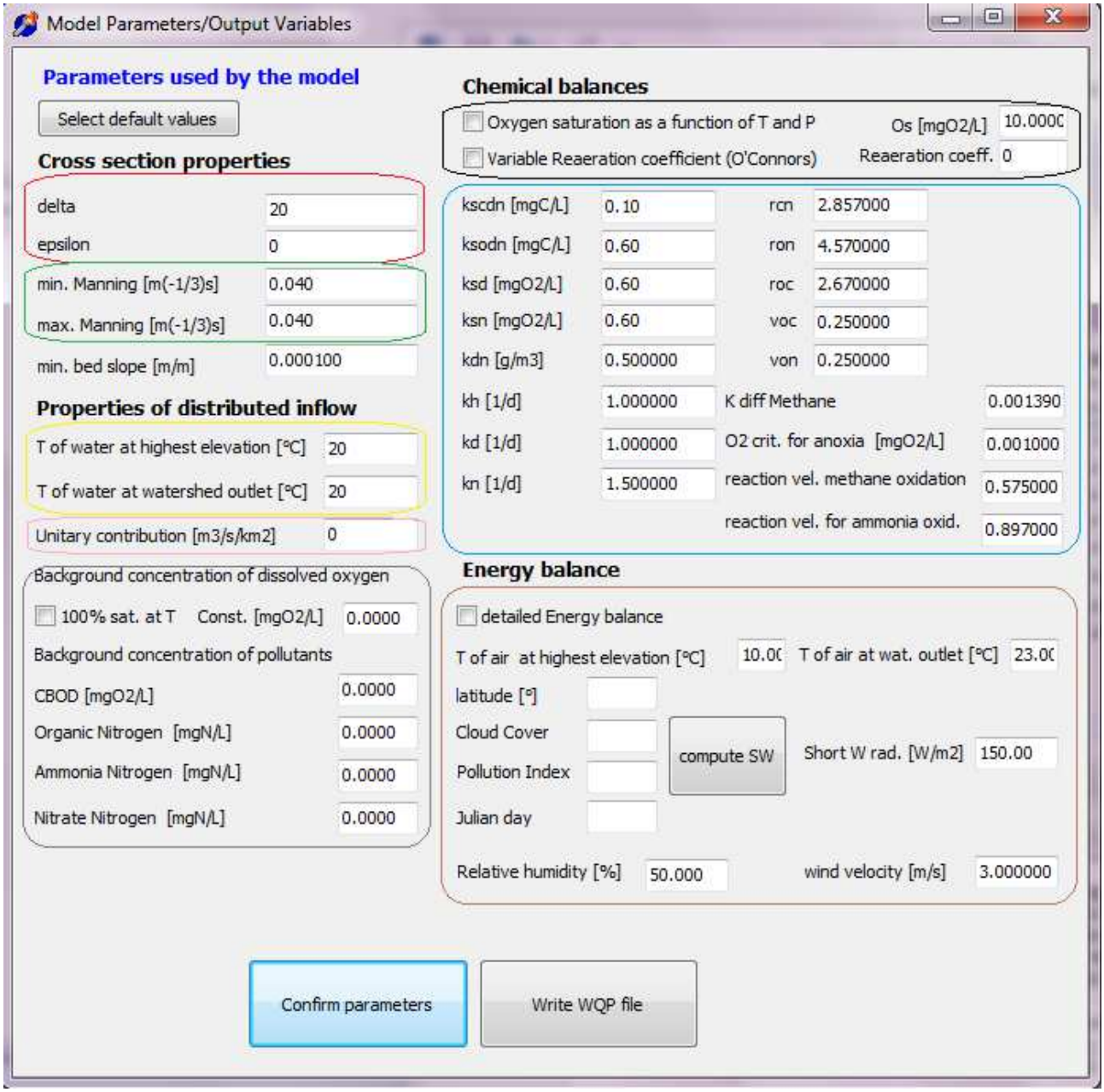
The meaning of this file can be easily understood by comparison with the pollutant loads summarized in Table 3 of the Companion paper.
When this file is read, immission or withdrawal points are marked along the CN with yellow points. For instance, the two pollutant immissions of this test case are marked as shown in the panel below.



Now Select Command 2: Generate Default File of Parameters. This command generates the list of parameters used by the solver. Initially all the cells are blank and the mask looks like the following



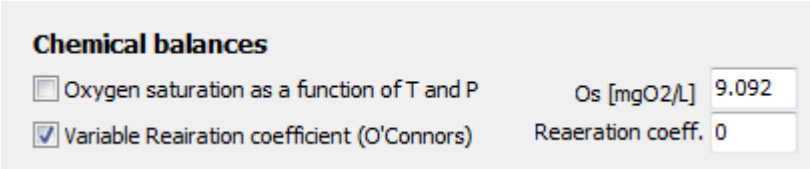
Press Select Default Values and the default values for all the parameters will be loaded as in the following panel.



The red line above encircles the parameters for controlling the river width as a function of the drained area (eq. 2 of the paper), whereas the green line is related to the variation of the Manning's coefficient as a function of the drained area. If one selects the same value for the minimum and the maximum, the Manning's coefficient does not vary. The same is true for the temperature of the local contribution from the groundwater, whose variation is controlled by the minimum and maximum within the yellow line.
In the first test case described in the paper, the river has a rectangular cross section, with constant width B (20 m) and Manning's coefficient n (0.04 $m^{-1/3}$ s). The water temperature is fixed at 20 °C. Accordingly none of the default values has to be changed

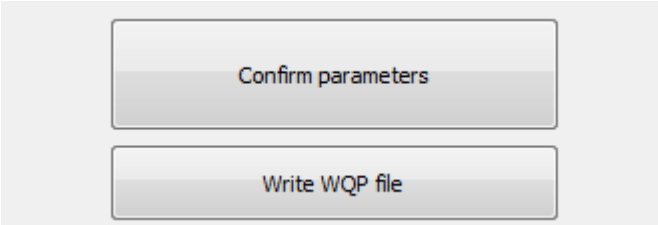
The pink line encompass the unitary flow contribution from the watershed. In this test case it will be zero. The grey line is related to quantities associated to the unitary flow contribution q from the groundwater of the watershed. In this case q is set to zero and accordingly nothing has to be specified here. Otherwise, one can select whether this contribution must be oxygen saturated or not, according to local temperature and altitude. Then it is possible to associate a pollutants load to q.

The blue line encompasses the value for all the chemical parameters. Their value will not be changed in the following.
As one can observe within the black line, the user can select both a variable reareation coefficient and a variable oxygen pressure saturation, as a function of T and atmospheric pressure. These two options can be activated by selecting the checkbox on their left. Otherwise, if constant values are selected throughout the CN, these can be specified on the right. In this test case a constant oxygen saturation concentration Os =9.092 mgO_2/L is selected (so, do not check the corresponding checkbox on the left but select 9.092 on the right) and a variable reaeration coefficient is computed for each cell with the O'Connor-Dobbins formula (check the checkbox on the left). Accordingly, that part of the panel should be modified as follows

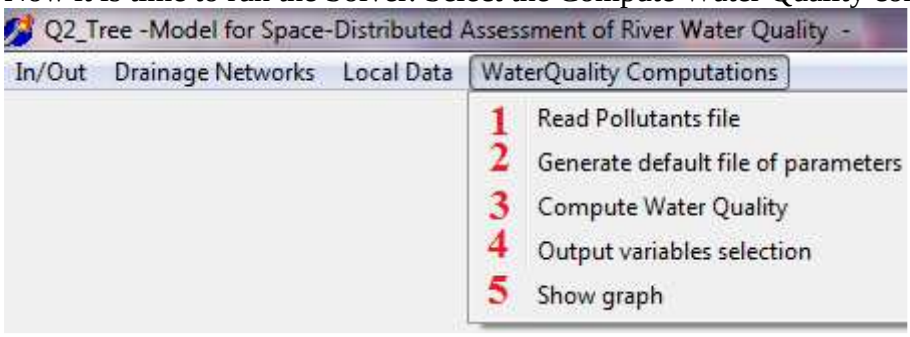


Finally, the brown line encompass parameters and options associated to the energy balance (more specifically, heat flux terms of Eq.(10) of the companion paper). If no parameter is selected and the option "Detailed Energy Balance" is left unselected as required in this case, the river water temperature is optained from Eq. (9) setting to zero the heat flux terms. Accordingly, in such a case the steady state temperature is simply a discharge-weighed temperature in the river.

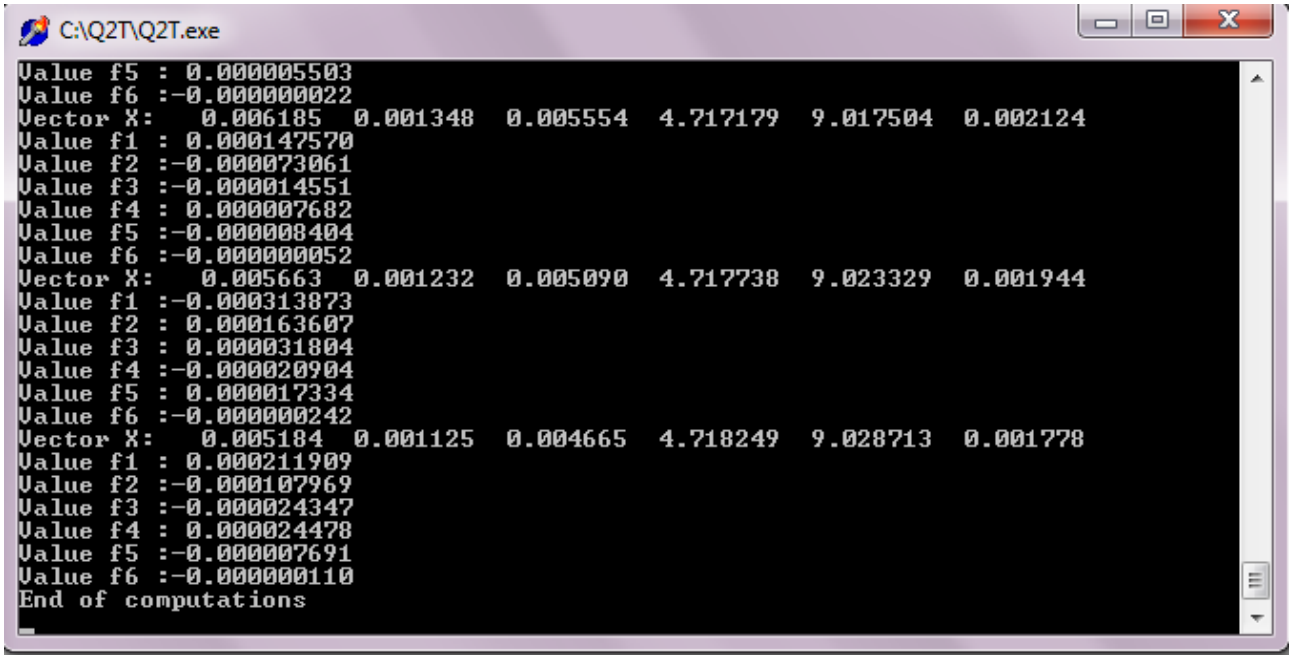
After introducing this modification, the user can press the Confirm Parameters and then the Write WQP file. At this point the WQP file that is one of the output of the program is written on disk and the mask is automatically closed.



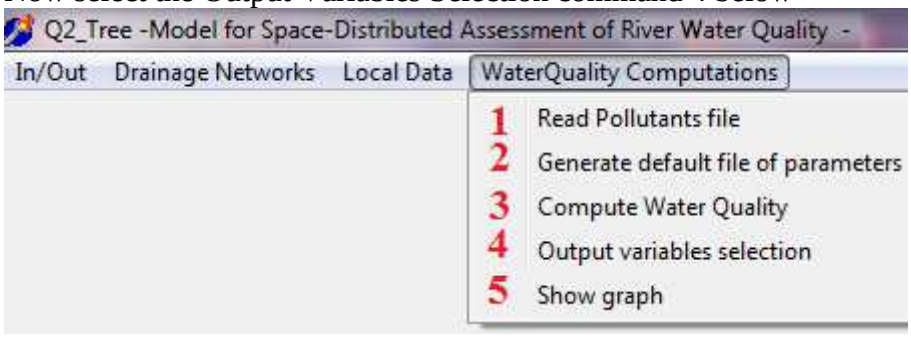
Now it is time to run the Solver. Select the Compute Water Quality command 3 below



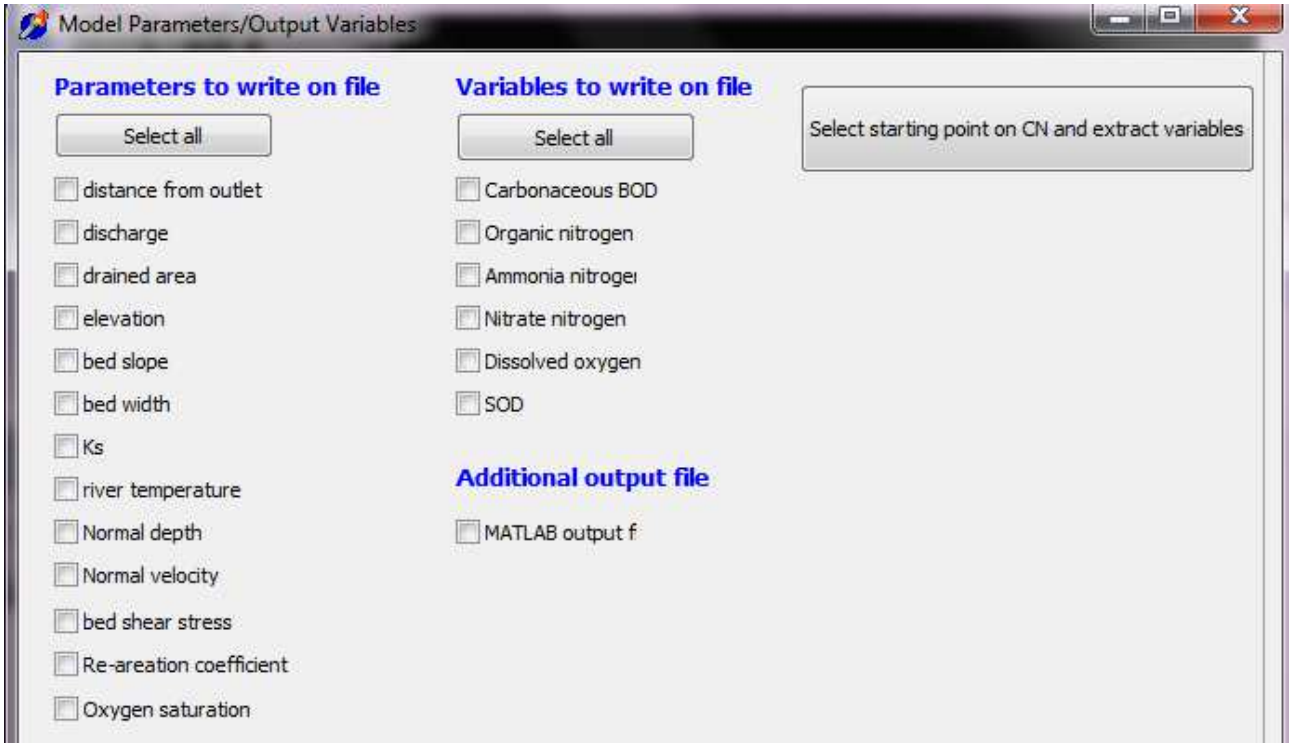
Upon selecting this command, the set of equations are solved moving according to the post-order algorithm along the CN. In order to show the progression of the computation, a DOS window is opened where for each cell the vector of solutions x_i i= 1..6 along with the corresponding value of the balanced functions is shown. When the "End of computations" line appears at the bottom, the solver has come to the end and the results are ready to be written on disk.



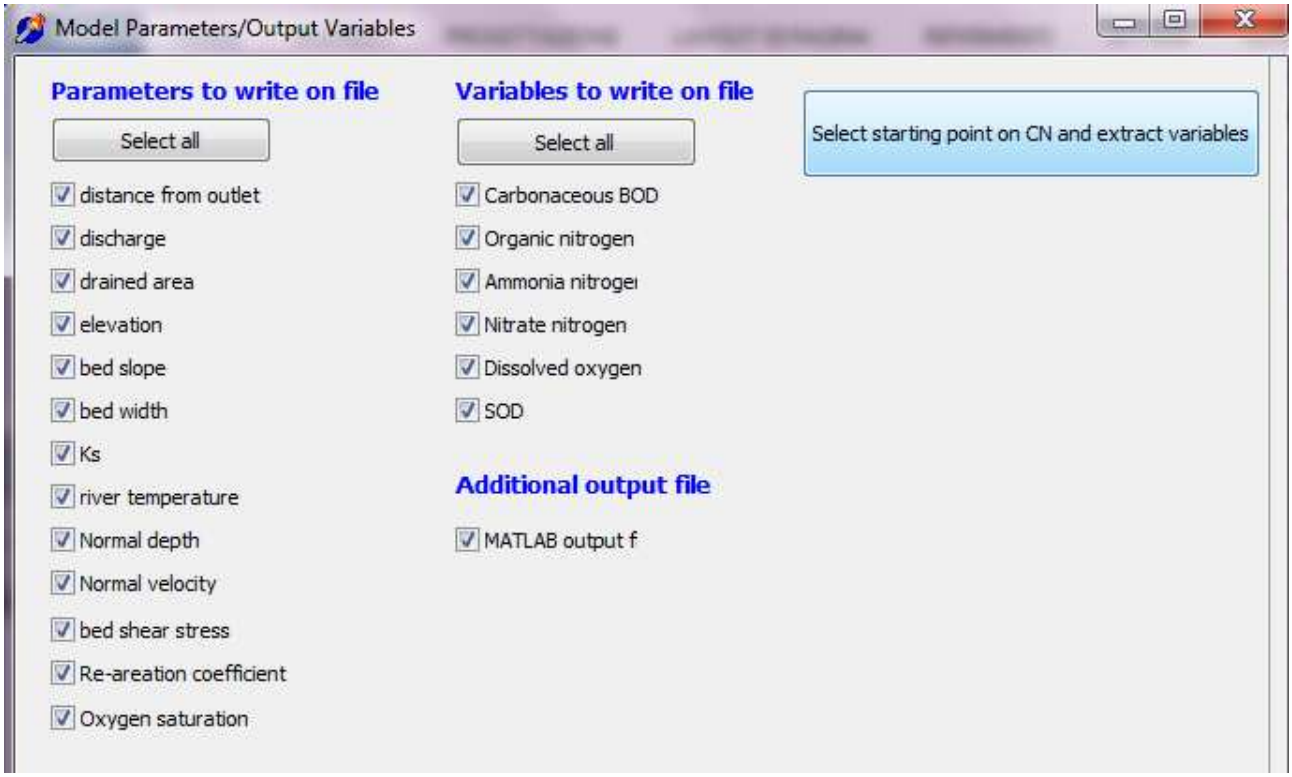
Now select the Output Variables Selection command 4 below



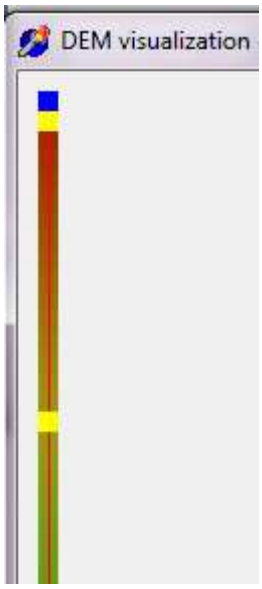
The panel below will show up. The idea behind this panel is that of selecting a point along the CN and printing on disk the computed quantities from that point downward as far as the outlet. In particular, by selecting each check box the user can customise the variables to print as well as can activate the writing of the MATLAB output file described in the user manual.



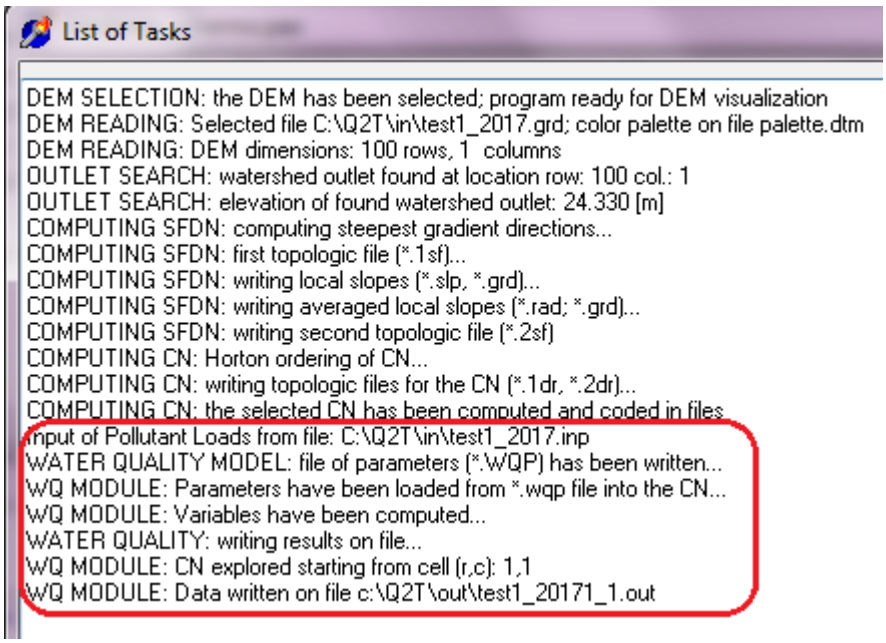
In the following we will “Select all” the variables



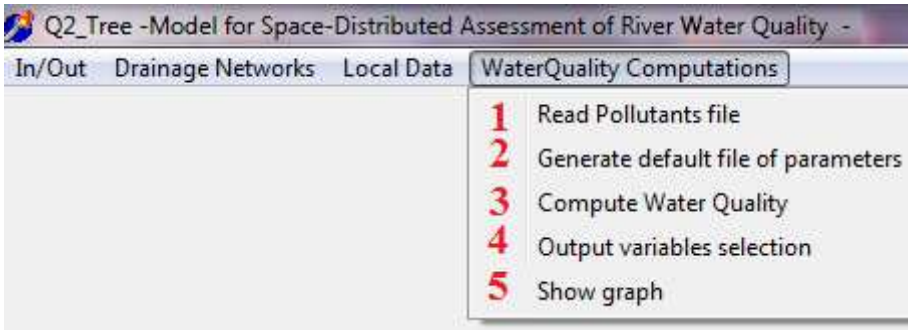
and we will press the “Select Starting Point on CN” button. By doing this the panel will automatically close and it will be possible to select the starting point on the CN in the “DEM visualization” panel. In order to do this, the user has to click with the left key of the mouse in correspondence of a node on the visualised outline of the CN. When the selected point as been recognised as being part of the CN, a blue square shows up on the CN and a beep is heard.



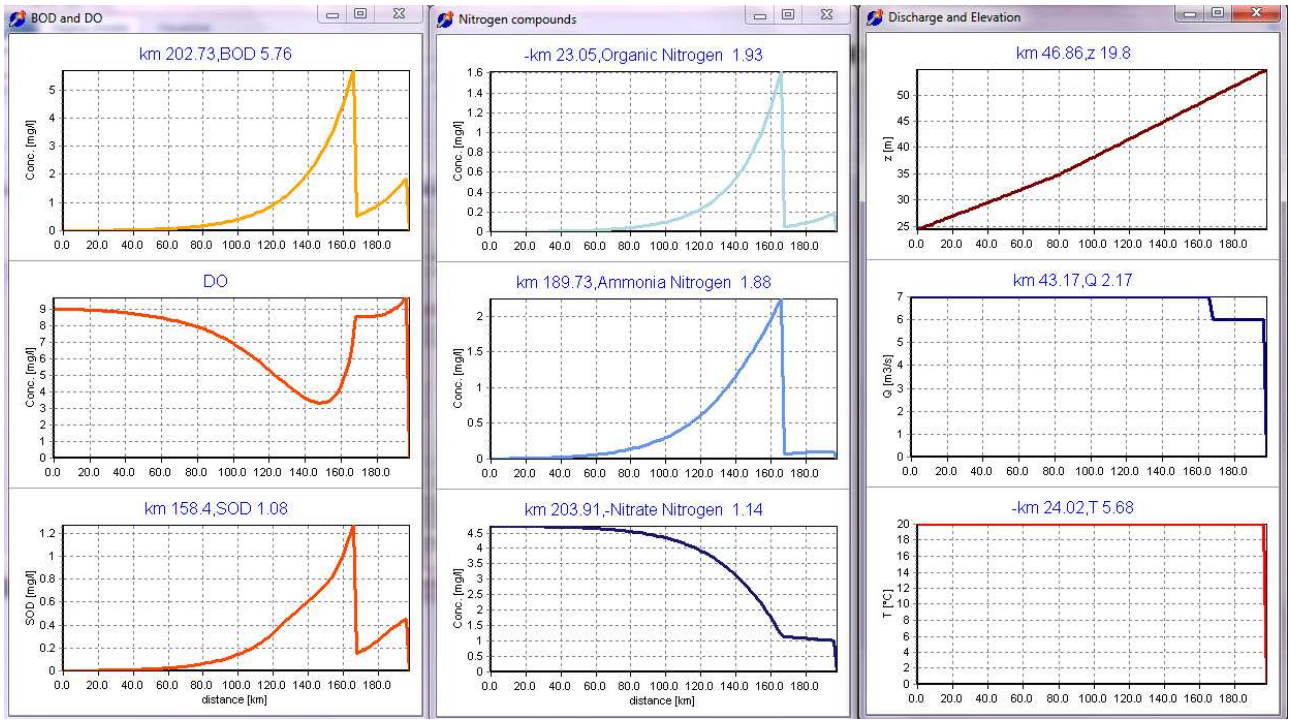
Moreover, a message appears in the “List of Tasks” panel (see last message encircled in red below) documenting that a file test1_2017 + 1_1.out has been written on file, where 1_1 means starting from the cell whose row is 1 and column is 1 in the DEM.



Eventually, by selecting the Show Graph 5 below



the space pattern of the computed variables is shown as below



Finally, in order to quit the program, click on the white cross at the upper right corner of the DOS panel.